Course guide
240722 - 240722 - Physics II

Last modified: 16/05/2023

Unit in charge:	Barcelona School of Industrial Engineering
Teaching unit:	748 - FIS - Department of Physics.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGIES AND ECONOMIC ANALYSIS (Syllabus 2018). (Compulsory subject).

Academic year: 2023   **ECTS Credits:** 6.0   **Languages:** English

LECTURER

Coordinating lecturer: Sempau, Josep

Others: Koubychine Merkulov, Youri Alexandrovich

TEACHING METHODOLOGY

The teaching methodology is based on four elements: (i) theory sessions, aimed at increasing the student's knowledge of the topics presented; (ii) practice sessions, devoted to provide students with problem-solving skills; (iii) laboratory sessions, oriented towards experimental and data-analysis abilities; and (iv) self-study, which involves studying without direct supervision in the classroom. This structure is intended to supply half of the knowledge, skills and competences expected from a freshman's physics course for engineers -the first half being covered in the "Physics 1" course.

During the theory sessions the fundamental concepts, together with some illustrative examples and relevant applications, will be presented. These sessions are expected to cover 20% of the total learning time.

Practice sessions will be used to learn solving numerical problems and exercises, encouraging students to actively participate with an inquiring attitude. This part is expected to cover 15% of the total learning time.

In the laboratory students will have the opportunity to gain hands-on experience about the application of the scientific method to solve practical problems. They will use experimental and data analysis techniques to take measurements, analyze the data generated and draw conclusions. The experimental work will take, including the preparatory steps in the classroom, 5% of the total learning time.

Finally, during self-study time students will be strongly encouraged to use some of these techniques: (i) read additional material suggested by the teacher, since reading from different authors with different viewpoints is a highly effective way to increase understanding of new concepts; (ii) work through practice questions to reinforce skills that are learned at the classroom; (iii) watch educational videos suggested by the teacher, or those found by students themselves, since this is a powerful way to keep students actively engaged in a concept; and (iv) discuss with your classmates about theoretical and practical aspects of the presented material.

Addendum:

As a result of the public health emergency declared for the COVID-19 epidemic of 2020, the methodology will be adapted to the new situation. This includes, but may not be limited to, teaching remotely using virtual meeting software platforms, cancellation of face-to-face experimental laboratory sessions, increase in the number of asynchronous assignments to be submitted by students (both individually and in small groups), etc.

These changes will be in place only during the spring semester of 2020.

LEARNING OBJECTIVES OF THE SUBJECT

The main objective of this course is to provide basic knowledge, skills and competences in the fields of electromagnetism and wave motion so that students are capable of using their principles and methods in a variety of applications in engineering.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours small group	8,0	5.33
Hours large group	52,0	34.67

Total learning time: 150 h

CONTENTS

1. Wave motion

Description:
Simple harmonic motion
Wave phenomena
Wave equation
Plane waves
Energy of a wave
The principle of superposition
Interference
Standing waves

Full-or-part-time: 19h
Theory classes: 4h
Practical classes: 3h
Self study : 12h

2. Electric interaction

Description:
Electric charges
Coulomb's law
Electric field & lines
Gauss' law
Electric potential
Work and electric potential energy
Electric dipoles

Full-or-part-time: 19h
Theory classes: 4h
Practical classes: 3h
Self study : 12h

3. Capacitance

Description:
Conductors and capacitance
Capacitors and their association
Energy and energy density
Polarization & electric susceptibility
Capacitors with dielectrics

Full-or-part-time: 19h
Theory classes: 4h
Practical classes: 3h
Self study : 12h

4. Current & direct-current circuits

Description:
Electric current, current density & continuity eq.
Electric resistance & Ohm's law
Conductors and insulators
Resistors and their association
Energy dissipation: Joule's law
Electromotive force & internal resistance
Kirchhoff's laws
RC circuits

Full-or-part-time: 23h
Theory classes: 4h
Practical classes: 3h
Laboratory classes: 4h
Self study : 12h

5. Magnetic interaction

Description:
Magnetic field and lines
Force on a moving charge. Trajectories
Hall effect
Magnetic force on current-carrying wires
Magnetic dipole moment. Force, torque and energy
The Hall effect
Biot-Savart & Ampere's laws
Magnetism in matter: magnetic susceptibility and permeability
Diamagnetism, paramagnetism and ferromagnetism

Full-or-part-time: 19h
Theory classes: 4h
Practical classes: 3h
Self study : 12h

6. Electromagnetic induction

Description:
Faraday's & Lenz's laws
Eddy (a.k.a. Foucault) currents
Electric generators
Mutual inductance, self-inductance & inductors
Magnetic energy and density
RL circuits
RLC circuits

Full-or-part-time: 23h
Theory classes: 4h
Practical classes: 3h
Laboratory classes: 4h
Self study : 12h

7. Alternating-current circuits

Description:
AC sources
RLC circuit with AC
Reactance, impedance and phase difference
Phasors and complex notation
Power in AC circuits
Resonance
Transformers

Full-or-part-time: 19h
Theory classes: 4h
Practical classes: 3h
Self study : 12h

8. Maxwell eqs & EM waves

Description:
Displacement current
Maxwell eqs
EM wave eq
Speed of light and EM spectrum
Energy flux and Poynting vector

Full-or-part-time: 9h
Theory classes: 2h
Practical classes: 1h
Self study : 6h

GRADING SYSTEM

The overall course grade is calculated as:

Grade = max(Grade_A,Grade_B)

with

Grade_A = 0.30 Probs + 0.30 Test + 0.20 Lab + 0.20 Midterm
Grade_B = 0.40 Probs + 0.40 Test + 0.20 Lab

where,
Grade: Final grade of the course.
Probs: Mark obtained in the problems exam.
Test : Mark obtained in the test exam.
Lab: Average mark of the laboratory reports delivered at the end of each lab session.
Midterm: Mark obtained in the midterm exam.

Students that fail the course will be given the opportunity to take a second-chance exam ("re-evaluation"). The final grade will then be:

Grade = 0.8 Exam2 + 0.2 Lab

where
Exam2: Mark obtained in the second-chance exam.

Note that the laboratory sessions will not be repeated and, therefore, the corresponding mark in the previous formula is the same value used for the first evaluation.

Addendum:

As a result of the public health emergency declared for the COVID-19 epidemic of 2020, the assessment method will be adapted to the new situation. This implies that: (i) Exams will be held remotely using the technical resources provided by the UPC such as, e.g., the virtual campus; and (ii) lab sessions will be replaced by asynchronous exercises to be performed in groups and submitted for grading. The weight on the final mark of the corresponding marks obtained in point (ii) remains the same as that used for the lab sessions in the formulas above.

This change will be in place only during the spring semester of 2020.

BIBLIOGRAPHY

Basic:
- Ling, Samuel J; Sanny, Jeff; Moebs, Bill. University physics. Houston, Texas: Rice University, [2017]. ISBN 9781680920437.
- Halliday, D.; Resnick, R.; Walker, J. Fundamentals of physics [on line]. 10th ed. Hoboken, NJ: John Wiley & Sons, 2013 [Consultation: 24/03/2023]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=3059079. ISBN 9781118473818.

Complementary:
- Alonso, M.; Finn, E. J. Fundamental university physics. 2nd ed. Reading, MA: Addison-Wesley, 1980. ISBN 0201001624.